German Jordanian University
School of Applied Medical Sciences
Department of Biomedical Engineering

BM557: Medical Instrumentation Lab

Course Catalog
1 Credit hour (3 hrs laboratory) The aim is to know the basic principles of RC circuits, designing and building low pass, high pass and band pass active and passive filters and to find frequency response of various types of filters. Topics covered include building instrumentation amplifiers to compare it with the single chip, optocoupler working principle and its importance in biomedical field, operation, designing, and implementation of ECG circuit, and building simple PPG circuit then compare the signal with the one obtained from pulse oximetry. Moreover, the student will be able to work on two training Kit (i.e., the blood pressure and infusion injection pump training kit) in order to troubleshoot the possible faults.

Lab Instructor	
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Evaluation		
Assessment Tool	**Weight**	**Expected Due Date**
Lab Reports	30 %	Each report is due at the beginning of the next lab session
Quizzes	10 %	At any time in any lab session
Midterm Exam	20%	Assigned at the beginning of each semester
Final Exam	40%	Assigned at the beginning of each semester
Total	100%	After completing final exam

	Topics Covered	
Week	**Experiment No.**	**Topic**
1	----------	Lab Introduction
2	Experiment 1	Passive Filters
3	Experiment 2	Active Filters
4	Experiment 3	Instrumentation Amplifier
5	Experiment 4	Opto isolation
6	Experiment 5	ECG Part I
7	Exam	**Midterm Exam**
8	Experiment 6	ECG Part II
9	Experiment 7	Pulse Oximeter
10	Experiment 8 &9	Cardiac Rhythm I and II
11	Experiment 10	Infusion Pump Training Kit
12	Experiment 11	Blood Pressure Training Kit
13	Exam	**Final Exam**

Objectives and Outcomes	
Objectives	**Outcomes**
1.Build Passive filter (LPF,HPF and BPF).	1.1.Understand the basic principles of RC circuits 1.2.Design &build passive lowpass, high pass and band pass filters. 1.3.Find frequency response of various types of filters.
2.Build Active filter (LPF,HPF and BPF) and Notch Filter.	2.1.Design &build Active lowpass, high pass and band pass filters. 2.2.Design notch filter and measure the cut off frequency. 2.3.Find frequency response of various types of filters.

3.To be familiar in working with instrumentation amplifiers.	3.1.Build instrumentation amplifier from 3 operational amplifiers and resistor in specific connections then compare it with the single chip . 3.2.Measure gain and Common mode rejection ratio (CMRR).
4.Learning the importance of Optocoupler in Biomedical field.	4.1.Check the operation of photodiode and of a phototransistor and an integrated opto-isolator. 4.2.Compare the result between the isolated opto-coupler and integrated type .
5.Learning how to work on the ECG device and deal with operation manual.	5.1.Understand the Operation ,Designing, implementation ,troubleshooting , of the ECG Device. 5.2.Recording ECG signal with 6 leads. 5.3.Dealing with operation manual of the device.
6.To understand the operation of photoplethysmography as an optical measurement method .	6.1.Recognize the performance of a simple PPG circuit 6.2.Build and analyze a simple PPG circuit using a LabVIEW. 6.3.Compare the signal that was obtained from the circuit with the one from the SPO2 device.
7.Analyze each block diagram of cardiac Rhythm experiment then using optical sensor to calculate the Heart rate .	7.1.Analyze the operation of the preamplifier. 7.2.Analyze the operation of the variable gain and amplification block. 7.3.Analyze the operation of the analogue-pulsed conversion block. 7.4.Measure the cardiac frequency by means of an optical sensor.
8.Dealing with Blood pressure training kit.	8.1.Working on the blood pressure training kit and make a faults , then the student try to guess the position of the block from which part of the circuit.
9.Dealing with Infusion Pump training kit.	9.1.Working on the Infusion Pump training kit and make a faults , then the student try to guess the position of the block from which part of the circuit.

Lab Report Requirements	
Report section	**Description**
Introduction	This section should provide the context and motivation for the experiment, briefly explain relevant theory in sufficient detail, introduce any relevant laws, equations, or theorems, and clearly state the aim or research question that the experiment is designed to address. You should try to write it in your own words, rather than paraphrasing the lab manual (but if you have to, be sure to include the appropriate references). It's always a good idea to read the entire experiment in the manual before

	you begin your introduction.
Procedure	This section must include a description of the procedure followed. It should not simply be a re-statement of the procedure section of this manual. You should interpret the procedure section and develop your own step-by step method.
Results	In this section, you present the main data collected during your experiment. Each key measurement needs to be reported appropriately. Data are often presented in graphs, figures, or tables. These need to be labelled appropriately to clearly indicate what is shown. Tables should be labelled numerically above the table as Table 1, Table 2, etc. Everything else (graphs, images, diagrams etc.) is labelled numerically below the figure as Figure 1, Figure 2, etc.
Discussion	This section should demonstrate how will you understand what happened in the experiment. You should identify and comment on any trends you have observed, compare the experimental results with any predictions, identify how any sources of error might impact on the interpretation of your results, suggest explanations for unexpected results, and where appropriate, suggest how the experiment could have been improved.
Conclusion	This section should provide a message summing up what has been learned from the experiment such as: briefly restate the purpose of the experiment (the question it was seeking to answer), identify the main findings (answer to the research question), note the main limitations that are relevant to the interpretation of the results, summarize what the experiment has contributed to your understanding of the problem.
References	List all sources that you have referred to in the body of your report. These can include references to accepted literature values or equations you use in your calculations. You should use proper referencing techniques.
Appendix	It contains material that is too detailed to include in the main report, such as tables of raw data, software code or detailed calculations.
Formatting	Font type: Times New Roman. Font size: 12 for the main paragraphs and 14 bold for the titles. Justify the paragraphs. Numbering. Figures should be inserted in the center of the page and they should be labeled below the figure with font size 10. Tables should be inserted in the center of the page and they should be labeled above the table with font size 10.

Policy	
Attendance	Attendance will be checked at the beginning of each lab session. University regulations will be strictly followed for students exceeding the maximum number of absences (20%).
Reports	Each student must hand his\her own separate report. Laboratory reports are due to ***one week after*** the experiment was carried out and it will be collected at the beginning of each laboratory. If any report is not submitted to the TA by the deadline, it will be judged as "**LATE**".
Examinations	The midterm and the final exams are closed book tests. Students who are not able to attend an examination (medical or another emergency) must notify the instructor. Make up tests require a Valid University excuse.
Student Conduct	It is the responsibility of each student to adhere to the principles of academic integrity. Academic integrity means that a student is honest with him/herself, fellow students, instructors, and the University in matters concerning his or her educational endeavors. Cheating will not be tolerated in at all. University regulations will be pursued and enforced on any cheating process.